Steven Bhairo

PED 4126 | Solutions | Due March 12, 2010

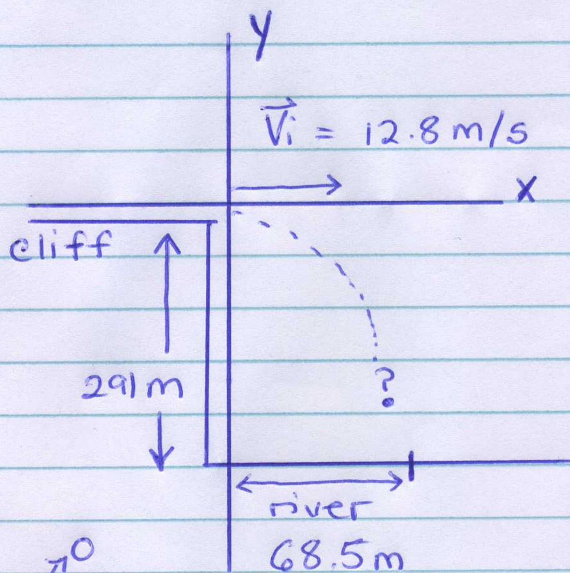
SPH4U: PHYSICS
GRADE 12 EXAM

Part A

1 C ✓
2 C ✓
3 B ✓
4 C ✓
5 A ✓

Part B

1(a) FBD:



✓

[4]

✓ $\Delta y = \cancel{V_{yi}}^{\,0} \Delta t + \frac{1}{2} a \Delta t^2$

$\Delta y = \frac{1}{2} a \Delta t^2$

$\frac{2\Delta y}{a} = \Delta t^2$

$\Delta t = \sqrt{\frac{2\Delta y}{a}}$

$\Delta t = \sqrt{\frac{2(-291\,m)}{-9.81\,m/s^2}}$

$\Delta t = \pm 7.7024\,s$

$V_x = \Delta x / \Delta t$

✓ $\therefore \Delta x = (12.8\,m/s)(7.7024\,s)$

$\therefore \Delta x \simeq 98.6\,m$

✓ ∴ The horizontal distance travelled by the rock (98.6m) was much greater than the width of the river (68.5m), the rock hit the ground on the far side

Part B cont.

1(b)

$V_{fy} = V_{iy} + a\Delta t$

✓ $V_{fy} = 0 + (-9.81)(7.7024)$

$V_{fy} = -75.561 \frac{m}{s}$

$|\vec{V_f}| = \sqrt{(V_x)^2 + (V_{fy})^2}$

$|\vec{V_f}| = \sqrt{12.8^2 + (-75.561)^2}$

✓ $|\vec{V_f}| = 76.6 \, m/s$

[3]

$\tan\theta = V_{fy} / V_x$

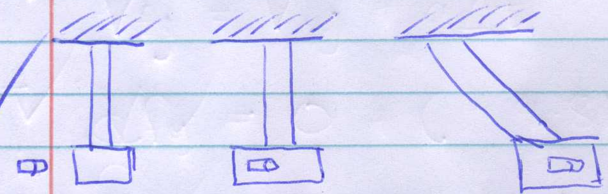
$\tan^{-1}\left(\frac{75.561}{12.8}\right)$

$\theta \cong 80.4°$

✓ ∴ The rock hit the ground with a velocity of 76.6 m/s @ an angle of 80.4° with the horizontal

Part B cont.

2 FBD



Bullet has initial Velocity

Momentum is conserved. KE is not

Mechanical energy is conserved

$E_K = E_g$

$\frac{1}{2}mv^2 = mg\Delta h$

$v = \sqrt{2g\Delta h}$

$V = \sqrt{2(9.81)(12.5)(1/100)}$

$V = \pm 1.566$

$m_b\vec{V_b} + \cancel{m_p\vec{V_p}}^{\,0} = m_b\vec{V_b}' + m_p\vec{V_p}'$

$\vec{V_b} = \frac{(m_b + m_p)\,V_{b/p}'}{m_b}$

$\vec{V_b} = \frac{[5.50\,kg/1000g + 1.75\,kg]\,[\cancel{1.566}]\,(1.566)}{0.00550\,kg}$

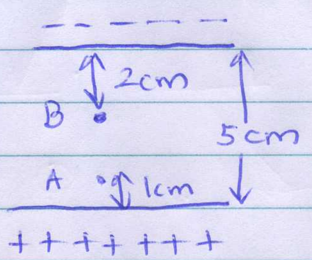
$\vec{V_b} \cong 5\times 10^2\ \frac{m}{s}$ [in positive direction]

∴ the velocity of the bullet just before the collision was about 500 m/s in the positive direction.

[5]

Part B cont.

3. FBD



(a) $|\vec{E_Q}| = \frac{\Delta V}{\Delta d} = \frac{80}{5\times10^{-2}} = 1.6\times10^{3}$

(b) $V_A = |\vec{E_Q}|\Delta d$

$V_A = (1.6\times10^3)(0.040)$

$V_A = 64\,V$

(c) $V_B = |\vec{E_Q}|\Delta d$

$V_B = (1.6\times10^3)(0.020)$

$V_B = 32\,V$

(d) $\Delta V = V_A - V_B = 32\,V$

~~(d)~~ (e) $\vec{F_Q} = q\vec{E_Q}$

$\vec{E_Q} = (2\times10^{-6})(1.6\times10^3)$

$F_Q = 3.2\times10^{-3}\,N$ [away from positive plate]

~~(e) The force experienced by the small charge @ point A is 3.2×10^{-3} N.~~

[5]

4. $f = 5\,Hz$, $\theta_1 = 50^\circ$, $V_1 = 31\,cm/s$, $\theta_2 = ?$, $V_2 = 27\,cm/s$

(a) $\frac{\sin\theta_1}{\sin\theta_2} = \frac{V_1}{V_2}$

$\sin\theta_2 = \left(\frac{V_2}{V_1}\right)\sin\theta_1$

$\sin\theta_2 = \left(\frac{27}{31}\right)\sin 50$

$\theta_2 = 42^\circ$

(b) $\lambda_2 = \frac{V_2}{f_2}$

$f_2 = f_1$

$\therefore \lambda_2 = \frac{27}{5}$

$\lambda_2 = 5.4\,cm$

[5]

Part B cont.

5.
(a) Albert Einstien is Known as the father of modern physics. and is famously known for ~~the concept of~~ the ~~re~~ concept of relativity. This theory/concept explains gravitation as distortion of the structure of spacetime by matter, affecting the inertial motion of other matter. Moreover, Einstein is also Known for his famous mass-energy equivalence equation which is, $E = mc^2$. This equation says that the total (relativistic) energy associated with an object of rest mass m, moving at speed v relative to an inertial frame. If the object happens to be at rest in this inertial frame, then v is zero and ∴ (relativistic) energy is $E_{(rest)} = mc^2$ He proposed that at rest mass is a form of energy that is associated ~~Erest~~ with all massive objects, and there might be forces in nature that could transform mass into the more familiar types of energy or vice versa.

[4]